Intersection Scoring Tool Frequently Asked Questions (FAQ)

Category 1: General Questions

Question 1-1: a. During which stage should this tool be used?
b. Where can we find that excel spreadsheet?

a. The tool can and should be used for all phases of development including planning, preliminary design (schematics) and final design (PS&E). The most value will be when using it during the initial project scoping.

b. The tool can be found at: Intersections (state.tx.us)

Question 1-2: How is rural segment scoring tool related to the intersection tool? Is there a plan to combine all these tools in a single tool to minimize confusion or misunderstanding on what spreadsheets are required as more come into use?

These are two separate tools as of now. The segment scoring tool is applicable to rural roadways, whereas the intersection scoring tool is applicable to urban and suburban areas. Eventually, there will be integrated segment and intersection tools for both rural and urban roadway projects. The long-term plan is to have integrated segment and intersection tools for rural and urban facilities.

Question 1-3: Can the intersection tool be used for suburban or rural town intersections within urbanized boundary?

Yes, the tool should be used for all intersections within urbanized boundary or within the city limits.

Question 1-4: What is the timeline for urban segment and/or rural intersection tools?

The urban segment tool development will begin in 2022. The rural intersection tool will be developed after the urban segment tool.

Question 1-5: If the recommendations from the tool are not implemented, do we need to justify?

This tool is not intended to mandate intersection configuration selection or the implementation of other intersection characteristics. This is a scoping tool focused on how much we can improve safety on each individual project. However, the primary constraints preventing project from achieving optimal score should be documented on the "Reporting" tab. We understand scoping

decisions may impact project cost and overall District programming. The goal is for the tool to assist in design discussions and help Districts maximize the amount of safety we can get out of each project.

Question 1-6: What if the crossing streets/roadways have major changes? Examples: How do evaluate the proposed intersection configuration from 3-leg to 4-leg or from 4-leg to 3-leg? Widening roadways: how do you fill out scoring tool? Tool currently assumes capacity of approach legs is fixed. Cannot show a "widening" currently. Have to fill out existing a 4 lane, then start a new tool and fill out existing as 6 lane (for example).

The current version of intersection scoring tool assumes that there are no significant changes at the intersections, i.e., number of legs, crossing streets (one-way/two-way, speed limit, number of through lanes).

If users need to evaluate intersections with major changes, enter the proposed intersection characteristics (e.g., number of legs, lanes, projected AADT, projected pedestrian and bicyclist volume level, etc.) in the "*General Site Features*" section. The evaluation will be based on the proposed intersection. Comparison between existing and proposed intersection configurations cannot be conducted directly, so for reporting purposes, existing score would be "not applicable".

Question 1-7: How are frontage road intersections handled?

Each frontage road intersection with the crossing street/highway needs to be considered as a separate intersection. For example, a 3-leg intersection at a one-way frontage roadway can be analyzed by specifying the crossing frontage roadway as one-way.

Question 1-8: Is the Safety Scoring Tool required if no federal money is included?

All applicable TxDOT statewide construction projects – regardless of funding – are required to be evaluated with the tool, and to report safety scores. On-system locally let projects are also required to report safety scores. Off-system locally let projects are not required to report safety scores, but it is still recommended that the tool be used for local let projects that include urban intersections.

Category 2: Intersection Basic Information and Safety Performance Functions (SPFs)

Question 2-1: How recently were the SPFs developed?

While developing the intersection scoring tool, the team referred to a wide variety of literature and identified a number of state-of-art research reports (see references at the end of this document) that focused on modeling intersection crashes. All of them were developed in the last 5 years. It is worth mentioning previous studies have shown that most of the SPFs for roadway entities remain relatively stable over the years. The reference sources provided most of the safety performance functions. As new research, including Texas-specific research, develops new SPFs, they will be incorporated into the tool.

Question 2-2: Is SPUI considered in tool

The Single-Point Urban Interchange (SPUI) is not considered in the intersection scoring tool, because the safety performance or crash modification factor for SPUI is still unknown. We do recognize this as an item we plan to incorporate in a future update to the tool if the research is available.

Question 2-3: What types of crashes are considered in the tool? Does the tool use fatalities & injuries (KABC) crashes or total crashes (KABCO)?

The tool uses total crashes, i.e., all severity levels, KABCO. In terms of crash types, vehicular (single motor vehicle or multiple motor vehicle crash), pedestrian (a crash involving a pedestrian and a motor vehicle), and bicyclist (a crash involved a bicyclist and a motor vehicle) crashes are analyzed separately.

Question 2-4: Does the tool distinguish between truck and car traffic?

Trucks and passenger cars are not distinguished in the tool. The tool uses average daily traffic (ADT), which is consistent with the manner in which the SPFs were developed.

Question 2-5: Can the tool analyze 5-leg intersections?

For 5-leg intersections, there is only one control type ‘signal’ because the only SPF available for 5-leg intersections is for a signalized intersection. As more research becomes available in the future (particularly regarding 5-leg roundabouts), more options will be available to analyze for 5-leg intersections.

Question 2-6: If the intersection has two roadways with the same classification, how are the major and minor roadways identified?

The roadway with the higher traffic volume should be considered as the major roadway, and the roadway with the lower traffic volume is considered as minor. Both roadways may also have the same classification and similar elements.

Question 2-7: What is the effect of speed limit?

The speed limit affects the safety analyses in two ways: (1) depending on the speed limit, the base SPF varies. Two identical intersections (except for the speed limit) may have different safety scores. (2) the speed limit influences the pedestrian and bicyclist safety. The tool automatically selects the appropriate SPF based on the entered speed limit information.

Question 2-8: Why does the tool ask for crashes within 250 feet of the intersection? What if I want to extend to 500 feet?

Only crashes within 250 feet from the center point of an intersections should be counted as intersection crashes. A distance of 250 feet is consistent with how SPFs utilized in the tool were developed.

Question 2-9: How does the tool use observed crashes at intersections? What is the relationship between the observed crash number and the safety score for an intersection?

The tool uses observed crash numbers in two ways: (1) when determining the standard and optimal configurations, the tool uses observed crash number as well as other characteristics (i.e., volume, speed limit) to examine if the intersection meets the signal warrants; (2) when calculating the total weighted score of the corridor ("*StartHere*" tab), the tool uses the observed crash number at each intersection as its weighting factor. In the case that the intersection has experienced no crash (i.e., observed crash is zero), the tool uses predicted annual total crash number. For an individual intersection, the safety score is calculated based on annual predicted total crash number, the observed crash number has no effect on its score. In addition, the predicted crash number and observed crash number are independent. The tool does not utilize the empirical Bayes (EB) method to combine the two, because multiple safety performance functions are used when predicting the number of crashes and the commonly used EB method cannot be applied directly.

Question 2-10: How do we obtain NCHRP reports for the tables?

The NCHRP 17-68 and 17-70 reports are publicly available from the National Academy of Sciences website (https://trid.trb.org/view/1847942 and https://trid.trb.org/view/1580387,

respectively); The HCHRP 17-84 report is under review, and expected to be published in 2022; The NCHRP 17-58 final report is pending. Interested users can also contact DES-TSSA for the reference tables. More details of these studies can be found in the Reference section in the end of this FAQ.

Question 2-11: Which year of ADT should be used? Opening, existing, or design year?

The tool uses existing ADT (i.e., the current year ADT). The tool calculates scores between different configurations based on their relative safety levels.

Category 3: Elements and Crash Modification Factors (CMFs)

Question 3-1: Are peaking characteristics of the facility (such as peak hour) considered in the safety evaluation of the signalized intersection?

Peaking characteristics are not considered in the intersection scorning tool, because the tool mainly focuses on safety performance rather than the capacity. In almost all intersection SPF and CMF developments, peak hour characteristics are not analyzed.

Question 3-2: For the left-turn lane, does it matter whether the left turn lanes are on the major or minor approaches?

The element options and CMFs for left-turn lane are limited by information from the studies that documented the safety effects. The research report does not distinguish between whether the left-turn lanes are on major or minor roadways. Thus, left-turn lanes are treated equally on major and minor approaches in the tool. In addition, any left turn lane counts, whether on the major or minor approach.

Question 3-3: I am working of on HSIP project where free intersection is proposed to restrict to LTL from major road only. How can I evaluate intersection safety score?

Enter the total number of left turns that are prohibited. The research studies did not distinguish between major and minor roads.

Question 3-4: Will the number of inputs change in future?

As new research results become available, the tool will be updated periodically to incorporate the latest intersection safety studies. There will be changes on the elements as well as the options of each element. As such, the number of inputs will likely increase.

Question 3-5: Why is sight distance only required for unsignalized condition? Why is sight distance not considered for signalized intersections?

The safety impacts of sight distance are most critical for unsignalized operations. The CMF for sight distance (http://www.cmfclearinghouse.org/detail.cfm?facid=9656) was developed for stop-controlled intersections. For signalized intersections, the primary sight distance issue is for right-turns-on-red. We suggest that the analyst determines if AASHTO Green Book criteria are met for the right turns, and that right-turns-on-red prohibitions should be considered if the AASHTO Green Book sight distance cannot be achieved.

Category 4: Pedestrian and Bike

Question 4-1: How does the tool use bike and pedestrian data?

The tool considers peak hour ped & bike flow and annual ped & bike crashes in both directions of the roadway.

Question 4-3: How do I determine ped and bike demand for future condition if there is no existing bike/ped facilities?

TTI researchers have developed models and tools to estimate the pedestrian volume at intersections (https://cts.tti.tamu.edu/safetytools/). Users may refer to the tool to estimate the pedestrian volume for the future. The tool does need a few inputs, including: intersection control type; number of schools within 1 mile; commercial and multifamily proportion; posted speed limit (mph); and CBD indicator.

Category 5: Others

Question 5-1: Where can I find CRIS crash data?

Users (both internal and external to TxDOT) can use the TxDOT crash query tool to obtain crash data at an intersection.

The tool development team has developed a step-by-step instruction detailing how to obtain intersection crashes within 250 feet from the intersection specifically for the tool.

Question 5-2: Will the tool be updated on a regular basis?

Yes, the tool will be updated periodically. The update will (1) address comments and feedbacks received from users; and (2) incorporate latest intersection safety studies.

Question 5-3: If at an existing railroad highway grade crossing, an elevated intersection is proposed, how do I use the tool to evaluate that intersection?

The elevated highway intersection configuration can be analyzed as any other intersection. The current version of tool is only applicable to highway intersections. Railroad highway grade crossing or interchanges cannot be evaluated using the tool. See response to question 1-6 for additional details about how to fill out the tool.

Question 5-4: If the project limits have five intersections but only on 3 intersections are to be improved, should we include 3 or 5?

Users should include all 5 intersections in the tool. All the intersections within the project limits should be analyzed and included in the scoring.

Question 5-5: In metro areas, intersections will often already have all the options built out that are optimal in the tool. Are there other design options that can be included to help hone in on available improvements (type of right turn channelization - smart right, etc.)

The tool can only evaluate options where the safety affects are known. Future versions of the tool will consider other options if the research becomes available.

Question 5-6: Is the selection of alternative configuration based on ADT?

The tool does not automatically select an alternative intersection. Alternative intersections are evaluated only if the analyst selects them as an option. Specifically, the selection of alternative intersections (DDI, DLT, MUT, and RCUT) are based on two situations: (1) the predicted number of crashes, which is related to various factors, e.g., ADT, number of lanes, speed limit, etc. and (2) if the alternative intersection has been selected in existing, design 1 or design 2. In other words, if the existing is not an alternative, and the user does not consider any of them in design 1 or design 2, the tool will not consider alternatives in the optimal configuration. Only at least one of the existing, design 1 and design 2 is an alternative, the optimal would possibly be an alternative configuration.

Question 5-7: Can alternative intersection be considered for 3-leg

The tool currently considers only a 4-leg intersection as an alternative intersection.

Question 5-8: How do these tools apply to Preventive Maintenance Projects?

Just like the rural tools, the urban intersection tool will be required for urban PM, 2R, 3R, and 4R projects. See eligibility matrix for additional details on when the tool is required.

Addressing safety needs in every project is critical. In the past Cat. 1 project scopes may have been limited. But in order to improve system safety performance, every project (including Cat. 1) needs to consider including safety elements that might have previously been thought of as "out of scope". If we're thinking about safety in every project, there will be fewer missed opportunities for improvement.

Question 5-9: What is permissive, protective and permissive-protective signal phases

a. Permissive-only (also known as "permitted-only") phasing allows left turns after yielding to conflicting traffic and pedestrians.
b. Protected-only" phasing consists of providing a separate phase for left-turning traffic and allowing left turns to be made only on a green left arrow signal indication, with no pedestrian movement or vehicular traffic conflicting with the left turn.
c. Protected/Permissive (P/P) left-turn signal phasing is a combination of a protected phase, in which a green arrow indicates a protected turn, and a permissive phase, in which the left-turning vehicles must yield to the opposing traffic during the green indication.

Category 6: Visual Representations

This category provides visual presentations of a few intersection elements and alternative intersection examples included in the scoring tool.

6-1: Figure 6-1 illustrates negative offset left-turn lanes, no offset left-turn lanes, and positive offset left-turn lanes.

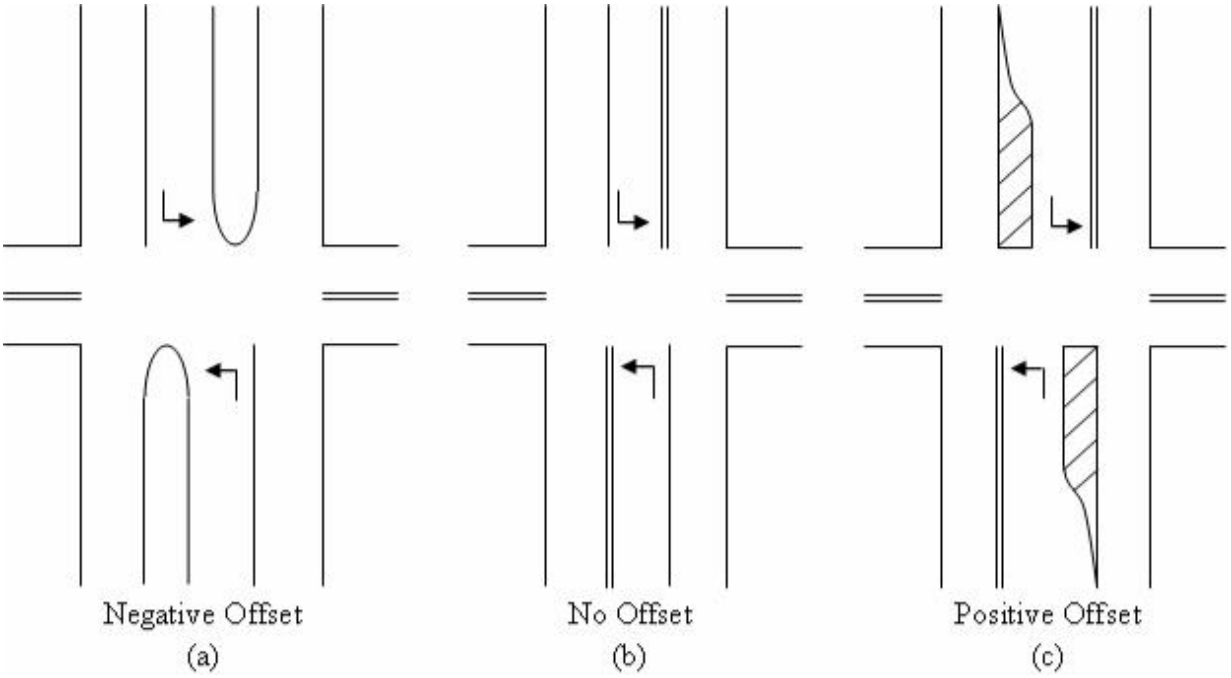
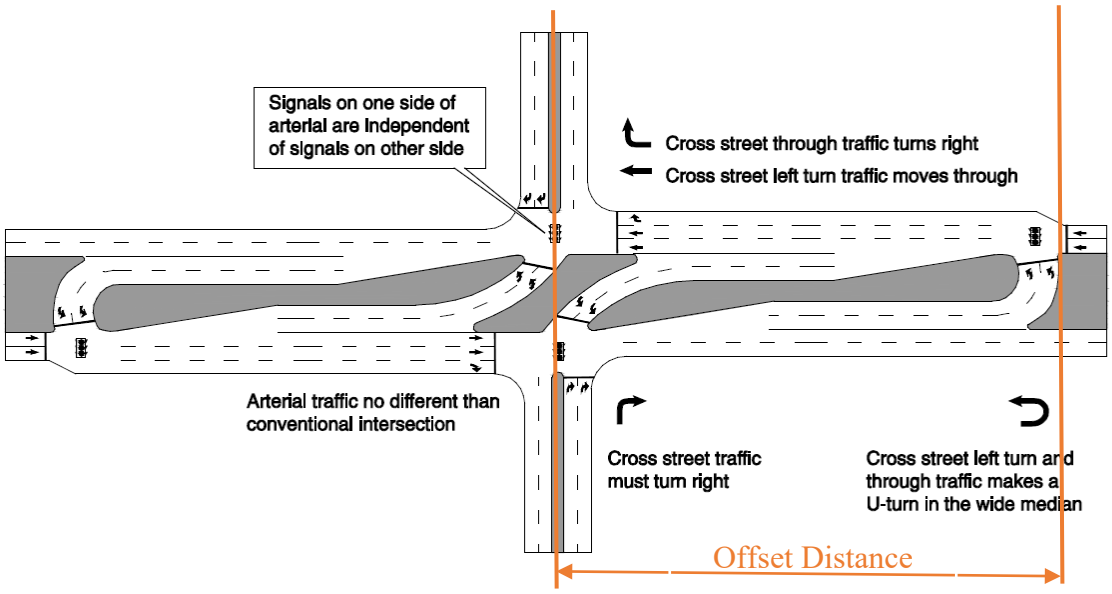
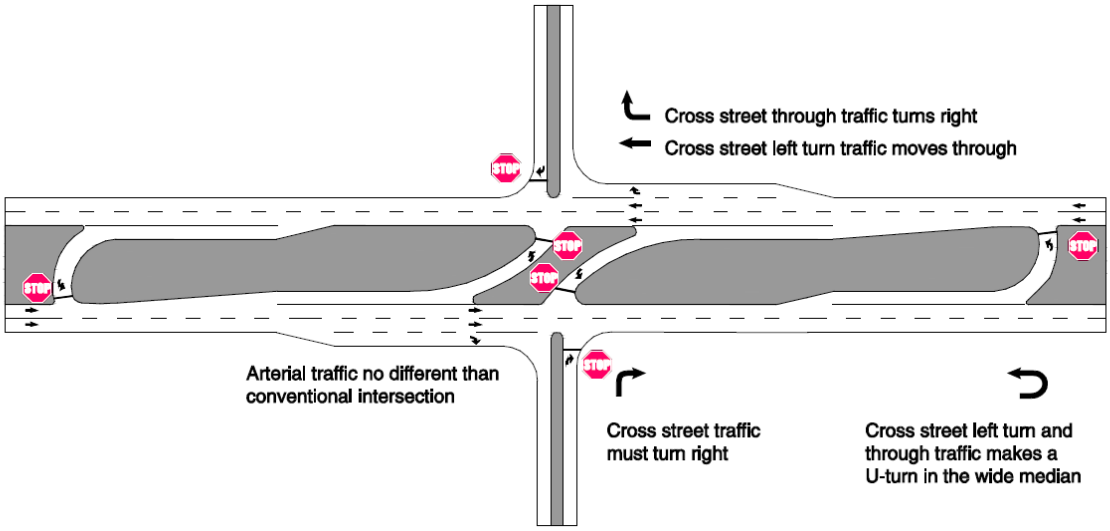


Figure 5-1 Left-Turn Lane Offset
Source: FHWA-HRT-09-035

6-2: Figure 6-2 illustrates RCUT intersections and their features.



(a) Example of a RCUT Intersection with signal



(b) Example of a RCUT Intersection with stop-control

Figure 6-2 Example of RCUT Intersections
Source: FHWA-SA-14-070

6-3: Figure 6-3 illustrates right-turn bypass lane at a roundabout.

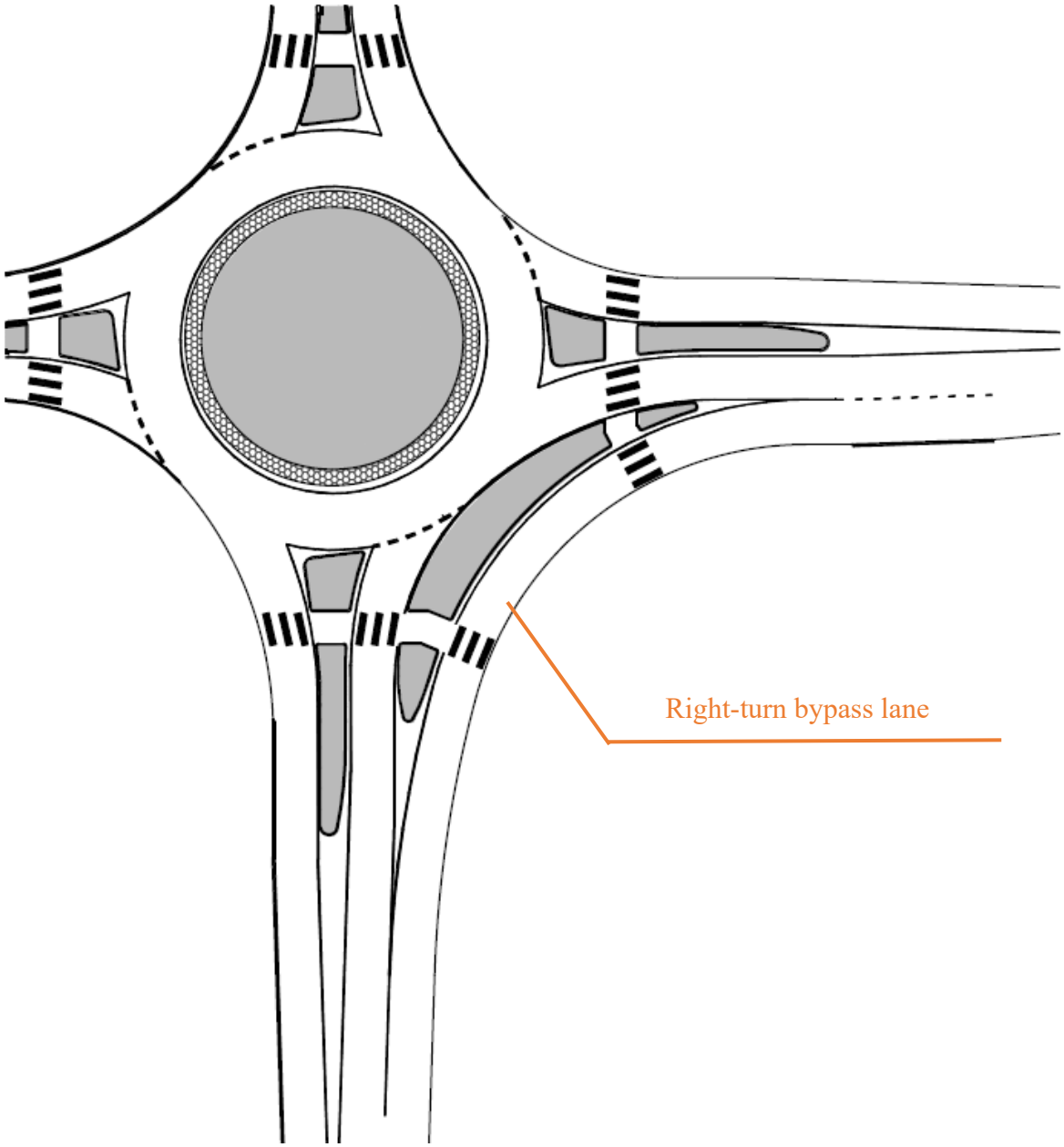


Figure 6-3 Example of right-turn bypass lane at a roundabout
Source: NCHRP Report 672

6-4: Figure 6-4 illustrates DDI intersection design sketch and its key characteristics

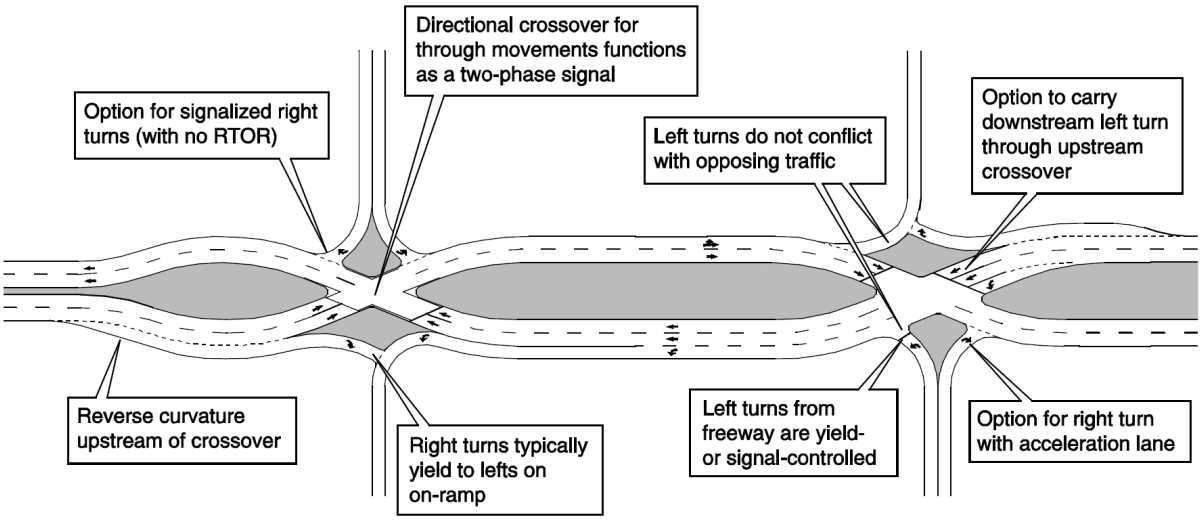


Figure 6-4 Example of a DDI intersection and its key characteristics
Source: FHWA-SA-14-067

6-5: Figure 6-5 illustrates a typical 4-leg DLT intersection design sketch

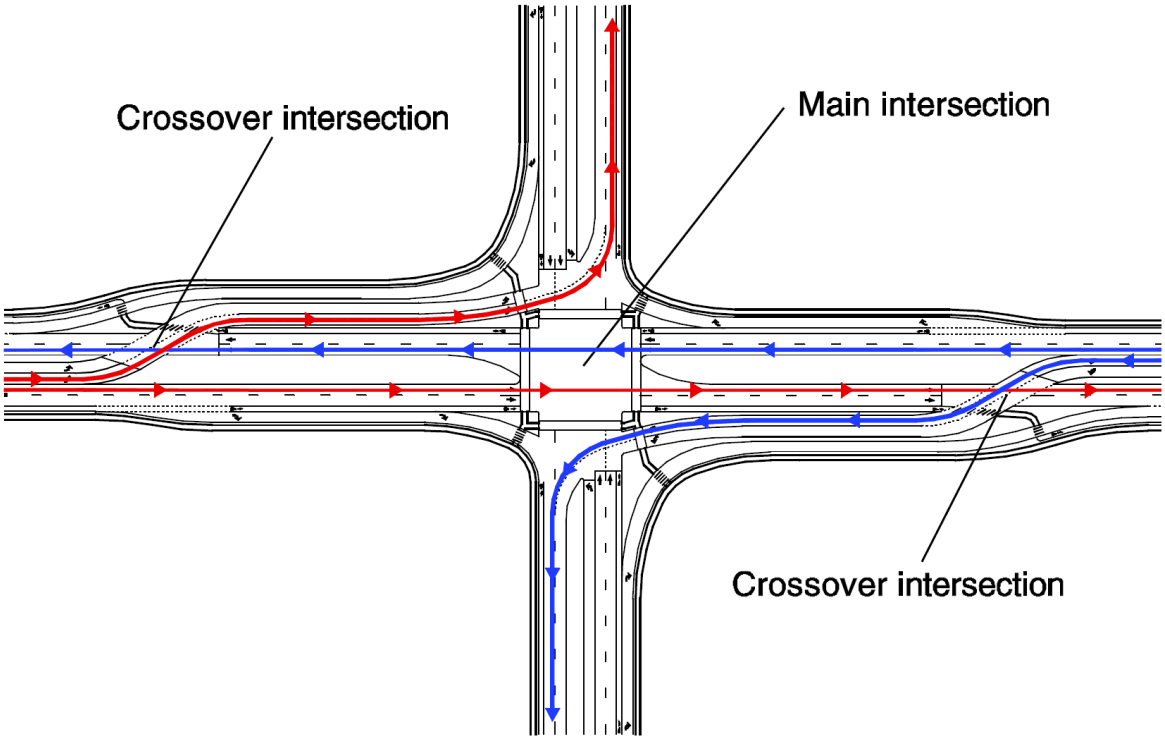


Figure 6-5 Example of a DLT intersection design sketch
Source: FHWA-SA-14-068

6-6: Figure 6-6 illustrates a typical MUT intersection design sketch

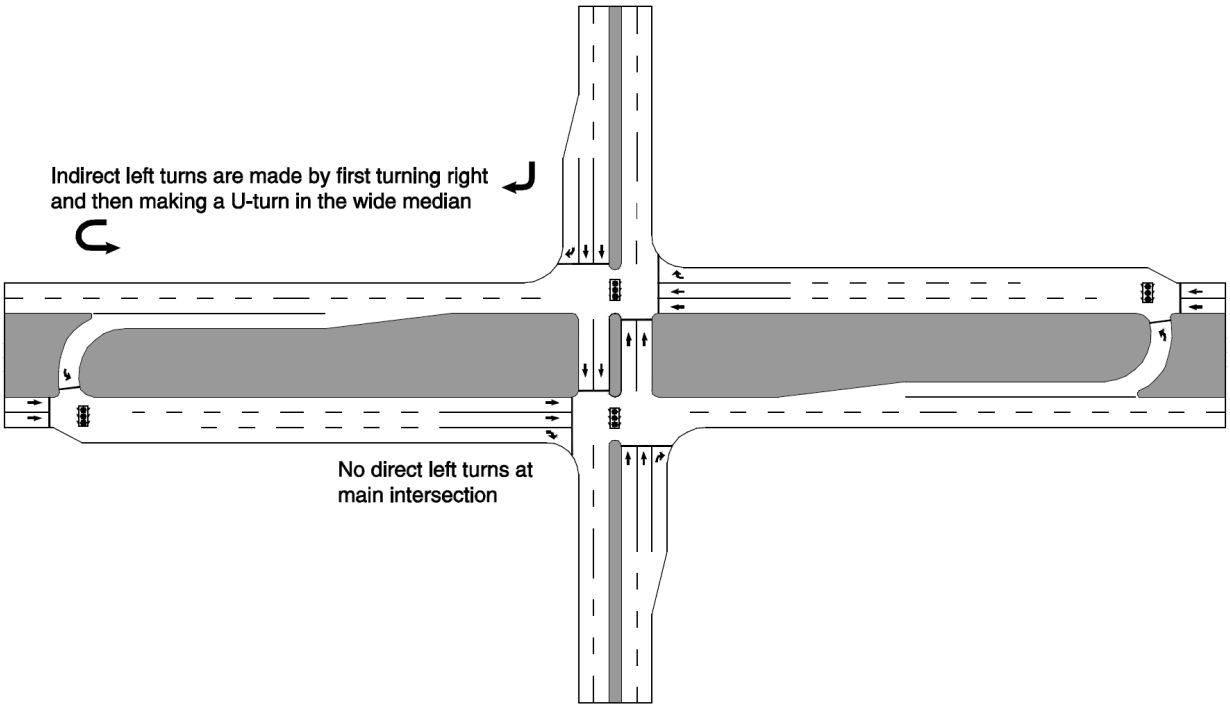


Figure 6-6 Example of a MUT intersection
Source: FHWA-SA-14-069

References

- Lord, D., S. Geedipally, M. Pratt, E. S. Park, S. H. Khazraee, and K. Fitzpatrick. *Safety Prediction Models for Six-Lane and One-Way Urban and Suburban Arterials*. No. NCHRP Project 17-58. 2017.
- Torbic, Darren J., Daniel J. Cook, Karin M. Bauer, Joseph R. Grotheer, Douglas W. Harwood, Ingrid B. Potts, Richard J. Porter et al. *Intersection Crash Prediction Methods for the Highway Safety Manual*. No. NCHRP Project 17-68. 2021. https://trid.trb.org/view/1847942
- Ferguson, Erin, James Bonneson, Lee Rodegerdts, Nick Foster, Bhagwant Persaud, Craig Lyon, and Danica Rhoades. *Development of Roundabout Crash Prediction Models and Methods*. No. Project 17-70. 2018. https://trid.trb.org/view/1580387
- Torbic, Darren et al. *Pedestrian and Bicycle Safety Performance Functions for the Highway Safety Manual.* No. Project 17-84. 2021 [*Final report still under review and not published yet*]